The Value of Planned Access on Urban Bypasses

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INTRODUCTION

The future of the American highway system depends upon the ability of the highway engineer to design and build highways which will provide the functional requirements of safe and rapid movement. The mounting accident toll and the increasing congestion and delay encountered on our highways testify to the inefficiency of our highway facilities and to their inability to perform the essential functions for which they were designed.

One of the most difficult problems facing highway and traffic engineers today is providing for safe and efficient movement of large volumes of through traffic in and around urban areas. The bottleneck of congestion and delay which confronts highway traffic in these areas must be broken if an adequate transportation system is to be developed.

The need for special bypass facilities for urban areas has been widely recognized but, unfortunately, too little emphasis has been placed upon insuring operational efficiency for these facilities. If accident rates and the provision for rapid movement are used as criteria of efficiency, very few present bypass systems could justly be termed efficient.

Some of the past design of bypass systems did not provide for both safe and rapid movement and, in many cases, did not insure that either would be maintained. Rapid movement of vehicles on these facilities plus the roadside interference resulting from increased development along them results in high accident rates which demand restricting regulations and traffic control. Speed controls, however, do not insure safe movement, and in the end one finds that the bypass becomes just another congested and hazardous city street.

The highway engineer has recognized that a means to provide the desired operating efficiency on urban bypasses is through the construction and use of controlled or planned access facilities. These facilities, incor-

porating the features of planned access, multi-lanes, divisional median and elimination of at-grade intersections are designed specifically to provide for the safe and efficient movement of through traffic. The term "planned access," instead of limited access or controlled access, is used in this paper because it is more descriptive of the feature. On a planned access highway the access points are not limited or controlled in the restrictive sense (that is how the average person views those terms) but are located at every point where access is required for the benefit of the community. The location of access points, in other words, is planned.

Public law 627, which provides for the construction of a national system of interstate and defense highways, recognizes the vital need for controlling access and insures that all of the bypasses for urban areas in that system will be of the planned access type. There will be, however, numerous bypasses built in the future by the various highway departments in this country on which full control of access will not be a fixed requirement. The Indiana Legislature wisely stated in legislation passed in 1955 that in the future the State Highway Commission shall designate and establish any bypass constructed a limited access highway. Full control of access, however, is not specified. An evaluation, therefore, of the merits and applications of planned access would be valuable.

THE KOKOMO AND LEBANON STUDIES

This paper reports a study made of two bypasses. In 1950 and 1951, nonlimited access bypasses were built around the cities of Kokomo and Lebanon, Indiana. The location of these bypasses with respect to the cities of Kokomo and Lebanon are shown in Figures 1 and 2. The first report of a study of the traffic and economic aspects of these two bypasses was made in 1953. The studies at that time were conducted approximately six months before and again six months after the opening of the bypasses to traffic. One of the conclusions in that report was that planned access, full control of access, was advisable for bypasses.

In 1957, an additional study to evaluate the longer-term effects of the bypasses and their operational efficiency was conducted. These studies provided data which very effectively point to the value of access control for urban bypasses.

Too often one fails to recognize the problem that will occur along nonlimited access facilities. When such facilities are first constructed, they are usually at the edge of the urban areas, and it is easy to minimize the trouble that can develop. However, a bypass constructed near an urban area and with unplanned connections to its local streets inevitably precipitates a great amount of development and change in the land use

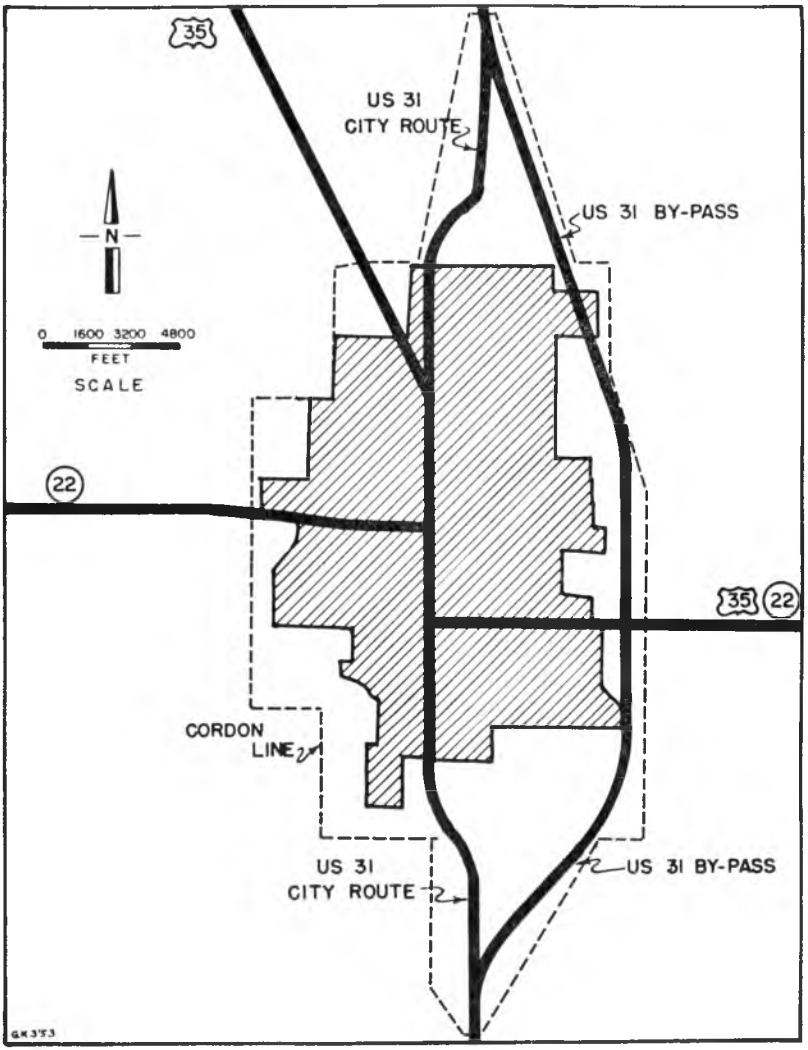

Figure 1. Kokomo, Indiana with highway routes and area of study.

pattern along the bypass. This growth in turn generates large volumes of relatively slow, local traffic which uses the bypass as a local street.

LAND DEVELOPMENT

For an example of this, the development along the Kokomo bypass is typical. Figure 3 shows the land use along the bypass as it appeared in 1948 just before the construction of the bypass. Figure 4 shows the land use in 1957, approximately six years after the opening of the bypass to

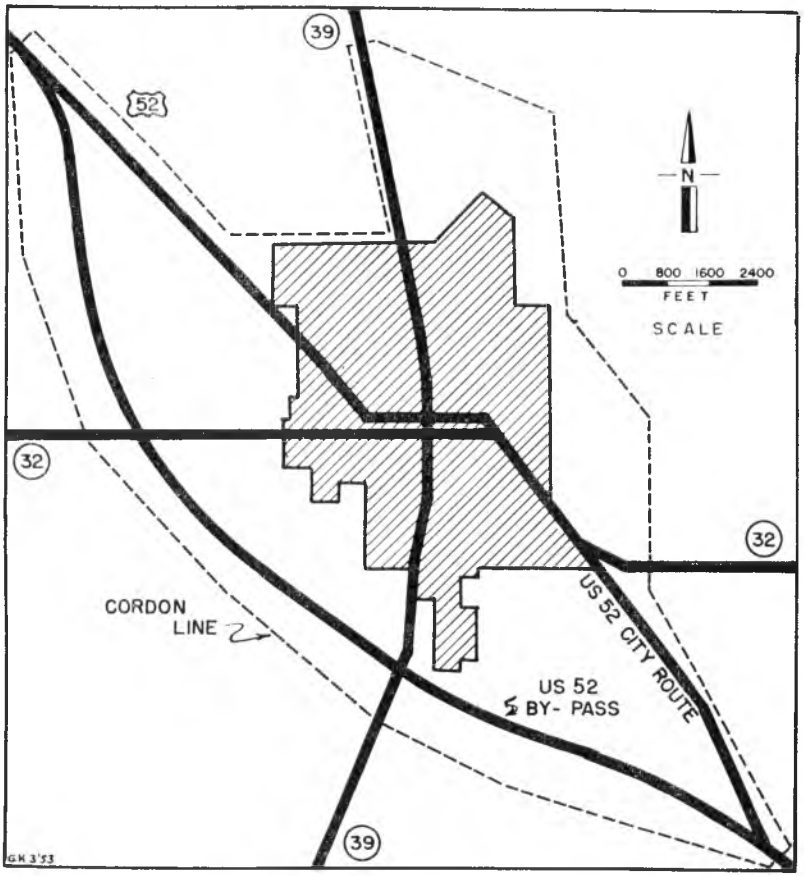

Figure 2. Lebanon, Indiana with highway routes and area of study.

traffic. Figure 5 is an aerial view of the bypass area in 1957 in which the development is obvious. The growth that has taken place includes a total of 27 businesses, an industrial plant employing 3,500 persons and nine subdivisions with provisions for 954 residences. It is easy to visualize the amount of local traffic on the bypass that this growth has generated.

It is true that the development thus encouraged by the facility is an asset to the community, but expeience in other states indicates that equal or more development occurs in the vicinity of planned access bypasses and that the deterimental effects on traffic movement do not result. Local traffic generated bv the development along planned access facilities use other local facilities for immediate access to the new developments.

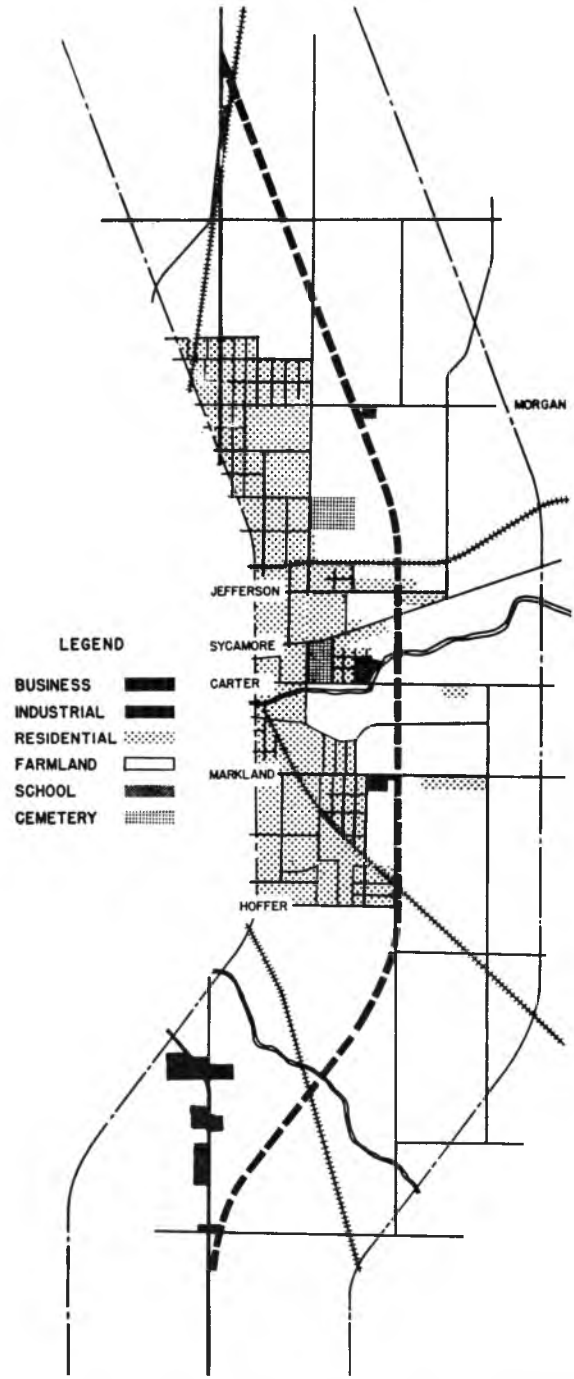

Figure 3. Land use of by-pass area, Kokomo, Indiana 1948.

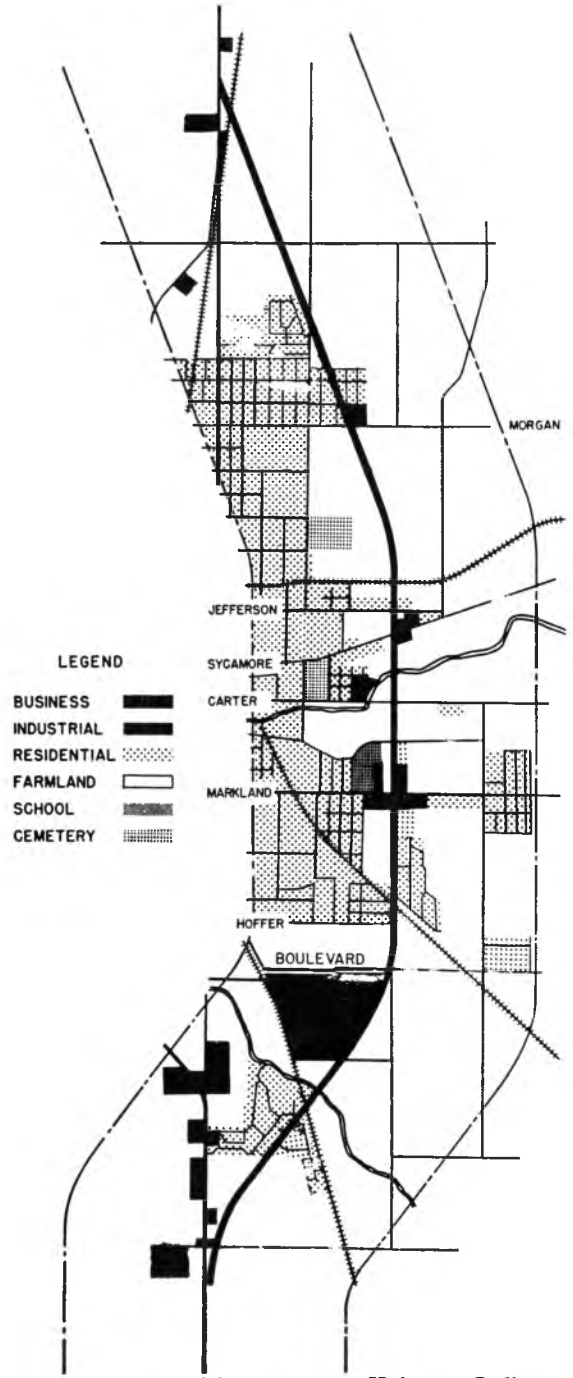

Figure 4. Land use of by-pass area, Kokomo, Indiana 1957.

Figure 5. Aerial view of the development in the vicinity of the Kokomo by-pass.

Thus, the special problem that develops on nonlimited access urban bypasses can be pictured. Rapid growth along the bypass will generate large volumes of slow local traffic whose characteristics conflict with those of the fast through traffic for which the bypass was built. This conflict results in a serious accident problem and inefficient operation on the bypass.

ACCIDENT STUDY

To evaluate the accident problem on the Kokomo and Lebanon bypasses, all reported accidents for a 5½-year period (1952-1957) on the Lebanon bypass and all reported accidents on the Kokomo bypass for a 4½-year period (1953-1957) were studied in detail.

Accidents on the Lebanon bypass totaled 235 for the 5½-year study period. This included a total of 12 fatal accidents in which 23 persons lost their lives. Property damage as estimated on the accident reports totaled $147,000. On the Kokomo bypass, a total of 339 accidents occurred during the 4½-year study period. These accidents included seven fatal accidents in which eight persons were killed. Property damage for this period totaled $205,000.

Figures 6 and 7 indicate that the accident problem on these bypasses has existed since the opening of the facilities.

Accident types—In an attempt to relate accidents to the functional elements of the facilities so that inefficiencies in design would be apparent, all accidents were classed into one of four types:

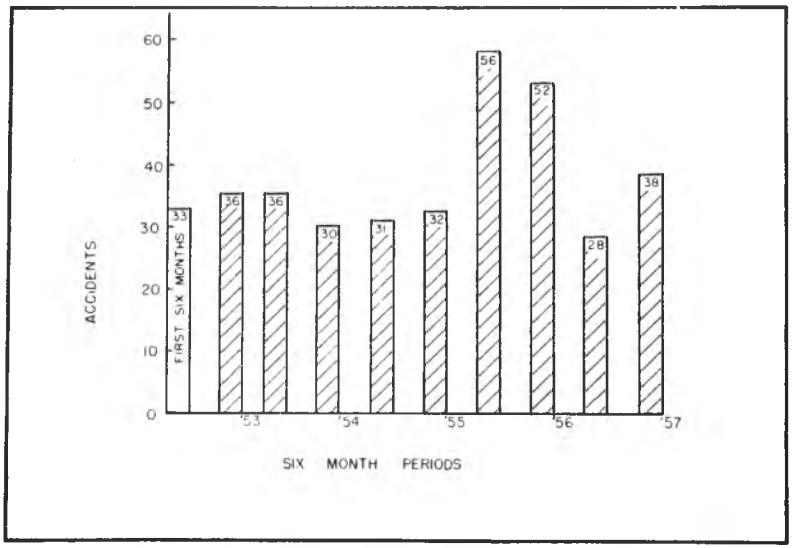

Figure 6. Accident rates on Kokomo by-pass.

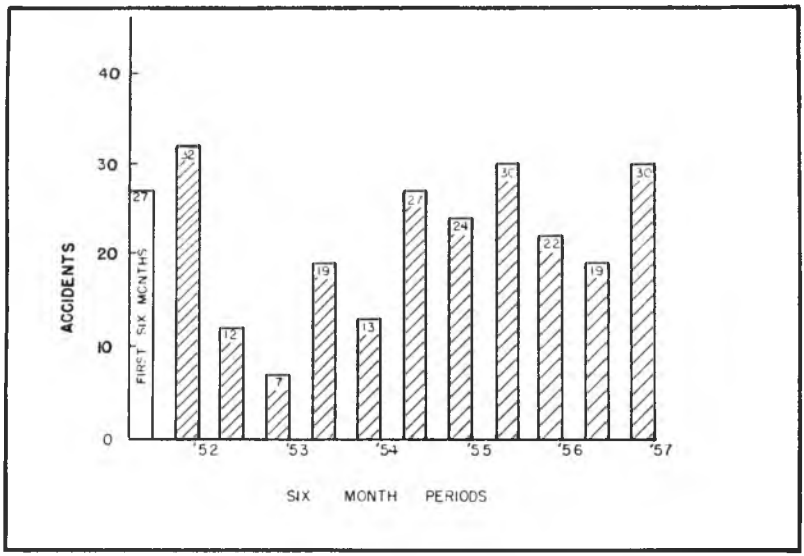

Figure 7. Accident rates on Lebanon by-pass.

Type I—Intersection accidents which occurred at the crossing of two traffic streams. These accidents were typically right-angle, turning, and rear-end collisions at intersections.

Type II—Marginal accidents which occurred along the moving edge of a traffic stream. These accidents resulted from vehicles attempting to get into or leave the moving traffic stream. Typical accidents were rear-end collisions, involving slowing down or accelerating vehicles near intersections.

Type III—Medial accidents which occurred between vehicles moving in opposite directions. Head-on collisions and sideswipes were typical of this type of accident.

Type IV—Internal-stream accidents which occurred among vehicles moving in the same direction. These included miscellaneous accidents such as running off the road, overturning, etc., and some rear-end collisions. This type of accident will occur on any facility.

The accidents by these types for the Lebanon and Kokomo bypasses are pictured graphically in Figure 8.

The Type I and II accidents are directly related to the lack of access control on the facilities and reasonably could be termed access accidents. Sixty-eight per cent of the accidents on the Kokomo bypass and 59 per cent of those on the Lebanon bypass were of these types. All

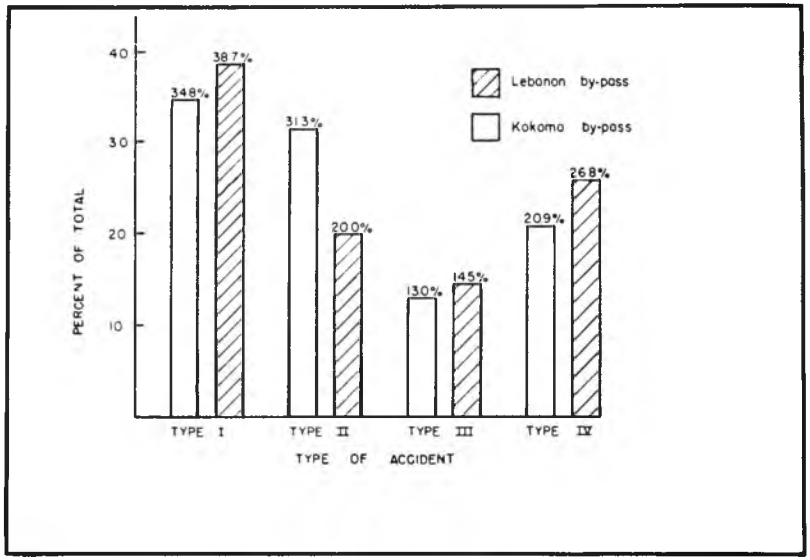

Figure 8. Comparisons of accident types.

streets which are permitted access to the bypass at-grade create the Type I accident, and all streets and drives with access to the bypass at-grade lend to the development of the marginal accidents.

The Type III accidents, those classed as medial accidents, are directly related to the fact that these facilities are two-lane. The construction of four-lane divided highways would, of course, eliminate most of these accidents. The construction of multi-lanes is dependent, however, on the presence of large traffic volumes. Both the Kokomo and Lebanon bypasses have sufficient volume to warrant four-lane divided construction, and such construction is programmed. The development of these facilities to four-lane divided facilities will result in the elimination of Type III accidents, a type which accounts for 13 and 14.5 per cent of the total accidents on the Kokomo and Lebanon bypasses, respectively.

A visual indication of the accident problem on these bypasses appears in Figures 9 and 10, which are spot maps of accidents on the Kokomo and Lebanon bypasses. It can be readily seen that the access points to the bypass are the focal point of the accident problem.

An analysis of these accident spot maps also indicates the effect of numerous access points and heavy use of a bypass by local traffic. The Lebanon bypass has a total of 29 access points and only two intersecting streets whose average daily traffic exceeds 400 vehicles per day. All other intersecting streets carry less than 400 vehicles per day. Use of the bypass by local traffic is relatively light, and turning movements at bypass intersections are light. The Kokomo bypass, however, has a total of 79 access points including six streets whose average daily traffic exceeds 1,100 vehicles per day. The origin-destination "after" study revealed heavy use of the bypass by local traffic which produced many short, local trips and large turning movements at the bypass intersections.

Access accidents (Types I and II) accounted for a total of 224 accidents on the Kokomo bypass for a 4½-year period, while only 138 such accidents were observed on the Lebanon bypass during a 5½-year period. Seventy-eight per cent of the accidents on the Kokomo bypass occurred in a 3.25-mile section of the bypass which had 43 of the access points, including five major intersecting streets. Rapid growth in the bypass area during 1955 and 1956 has resulted in increased use of the bypass by local traffic, and it was noted that accidents on the bypass increased during this same 2-year period.

In addition to the "access accidents" which have been discussed, the lack of access control on the bypasses also contributes to the overall accident problem. The basic cause of numerous accidents is a large velocity differential which exists between vehicles moving in the traffic

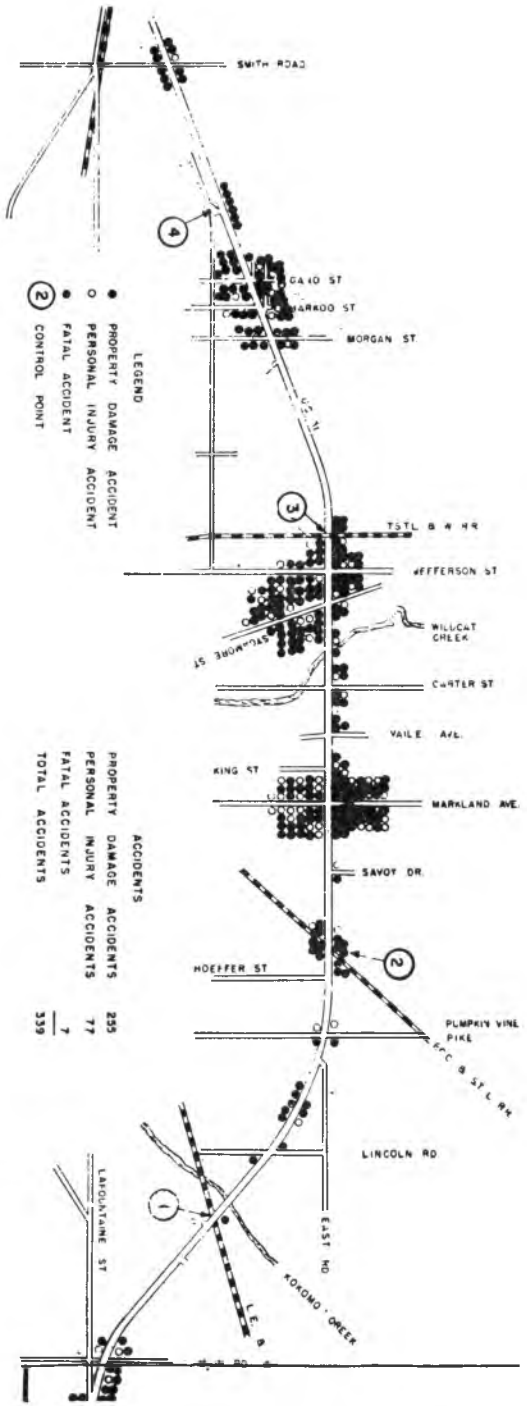

Figure 9. Accident spot map for Kokomo by-pass, January 1953-June 1957.

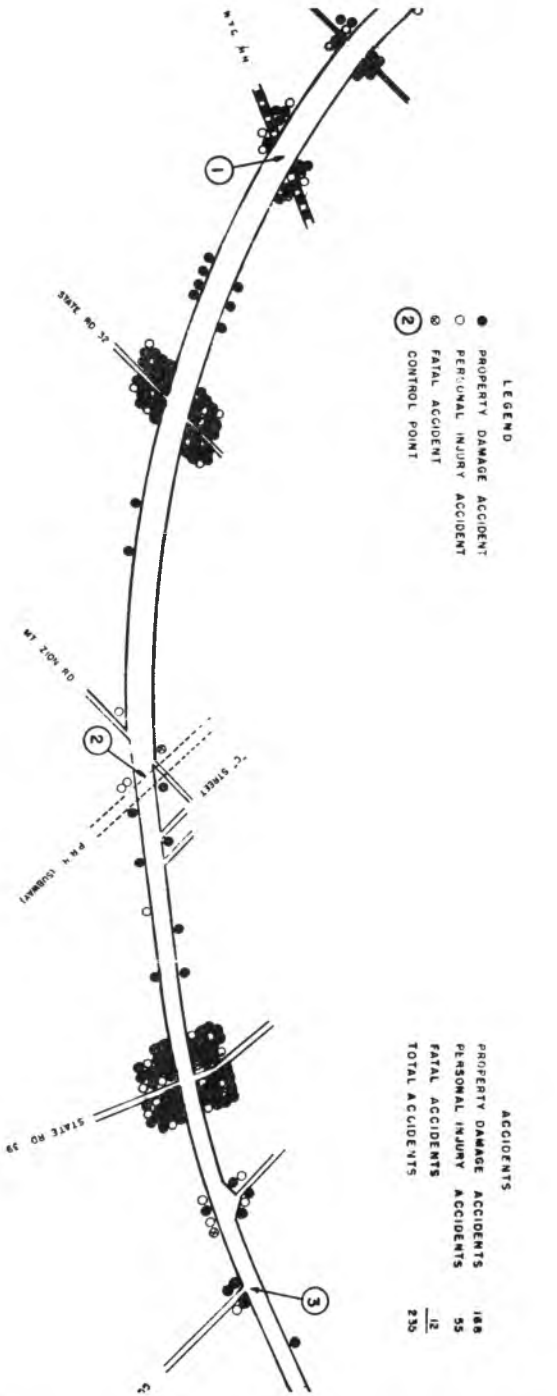

Figure 10. Accident spot map for Lebanon by-pass, January 1952-June 1957.

streams. Many accidents could be eliminated if traffic could be moved at a constant rate of speed somewhat near the desired speed of the through traffic. This is not possible, however, on nonlimited access facilities as the infusion of the slower traffic at the various access points forces the through traffic to move at changing rates of speed over differ-

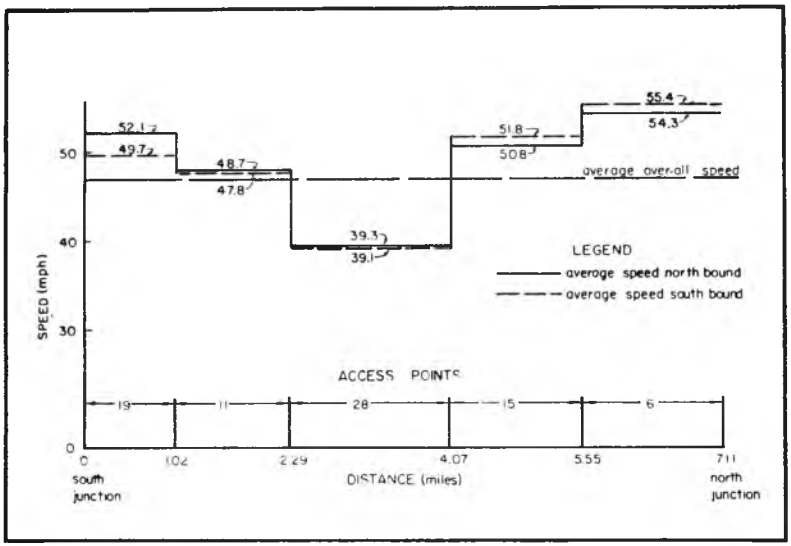

Figure 11. Average speed between locations on Kokomo by-pass.

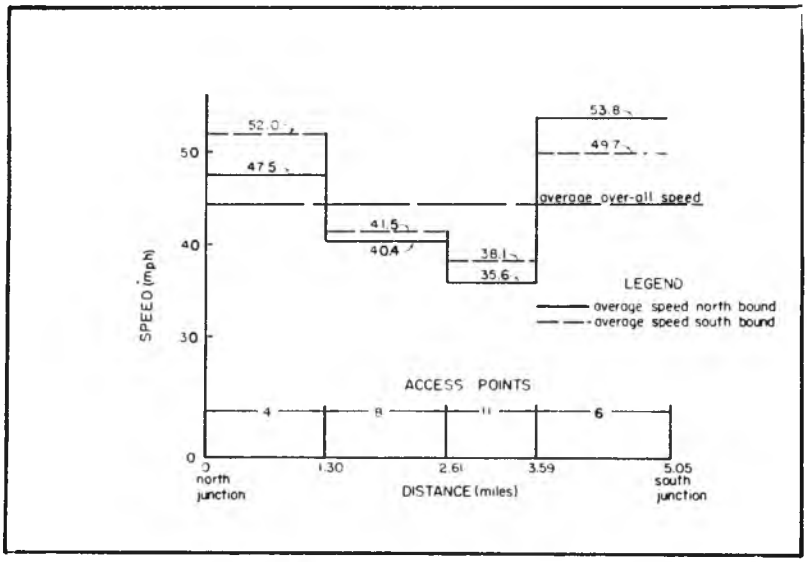

Figure 12. Average speed between locations on Lebanon by-pass.

ent sections of the bypass. Most of the accidents on the two bypasses occurred in those areas where the average speed was the lowest.

Speed studies placed the average speed on Indiana rural highways at 56.9 miles per hour in 1957. When this figure is compared with the speeds on the bypasses as shown in Figures 11 and 12, it is noted that a large velocity differential exists between the desired speed of the through traffic and the actual speed at which they can travel on the bypasses. Thus, the through motorist is forced to constantly vary his speed against his desires, and much friction is created within the traffic streams.

Accident costs—One major source of opposition to planned access construction is the high initial cost of obtaining the access rights and providing grade separations. Too often full control of access is eliminated by the question, "Can we afford to provide such a facility?" However, a better question would be, "Can we afford not to construct such a facility?" As one value for planned access, the savings resulting from eliminating certain accidents were determined.

The National Safety Council estimates the economic loss due to a fatality at $21,800 per death and the loss due to a personal injury at $950 per injury. Most people would agree that these estimates of human life and suffering are very conservative. When these figures are applied to the access accidents which occurred on the bypasses, however, it is apparent that large savings can result from access control.

Full control of access could reasonably eliminate all of the Type I and Type II accidents. Using the figures just quoted and property damage data from the accident reports, it was found that such accidents resulted in an average economic loss of $56,000 per year on the Kokomo bypass and $36,250 per year on the Lebanon bypass. Over a 25-year period and at 4 per cent interest, these costs would have permitted an additional expenditure at the time of construction of $885,900 on the Kokomo bypass and $566,400 for the Lebanon bypass. These amounts would have purchased a lot of access rights and provided for some of the grade separations if planned access had been included in the original plans for these bypasses.

An even greater saving would have resulted had a fully planned access, multi-lane, divided facility been provided. Such a facility would also eliminate all the Type III accidents. Using the same values for a human life and an injury and the estimated property damages, Type I, II, and III accidents have resulted in average annual losses of $80,500 and $100,000 on the Kokomo and Lebanon bypasses, respectively. Over a period of 25 years, and again charging 4 per cent interest, additional construction expenditures of $1¼ million for the Kokomo bypass and

$1.5 million for the Lebanon bypass would have been economically desirable to obtain planned access and multi-lane facilities.

These savings plus the benefits to traffic movement resulting from improved and more rapid movement indicate that planned access for urban bypasses has real value.

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